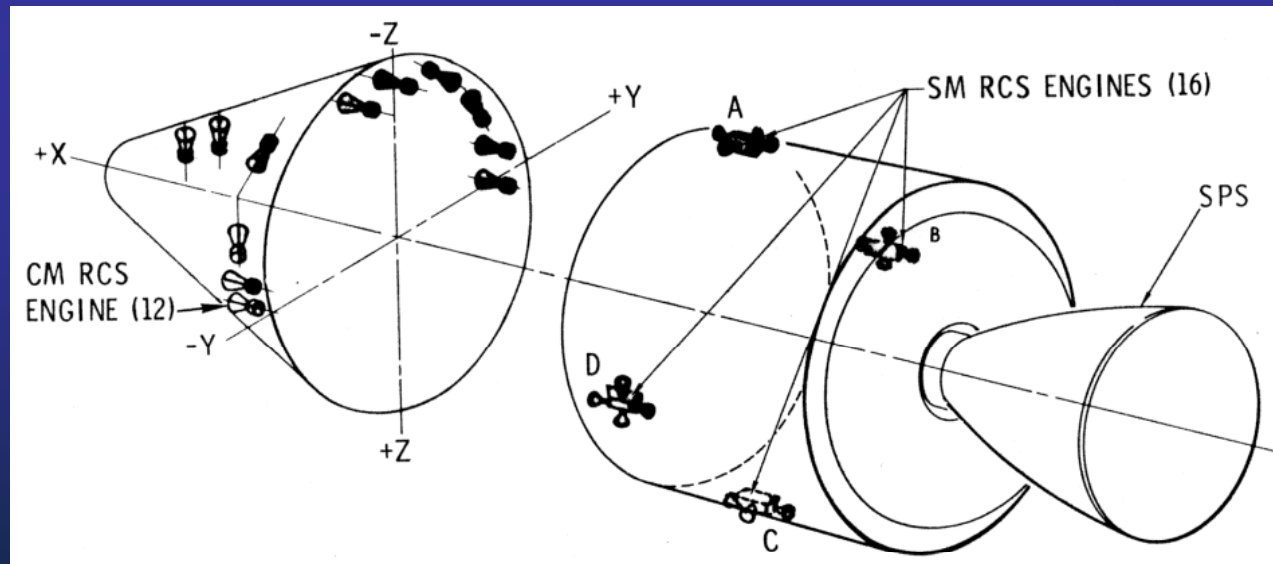


Apollo Command & Service Module Propulsion Systems Overview

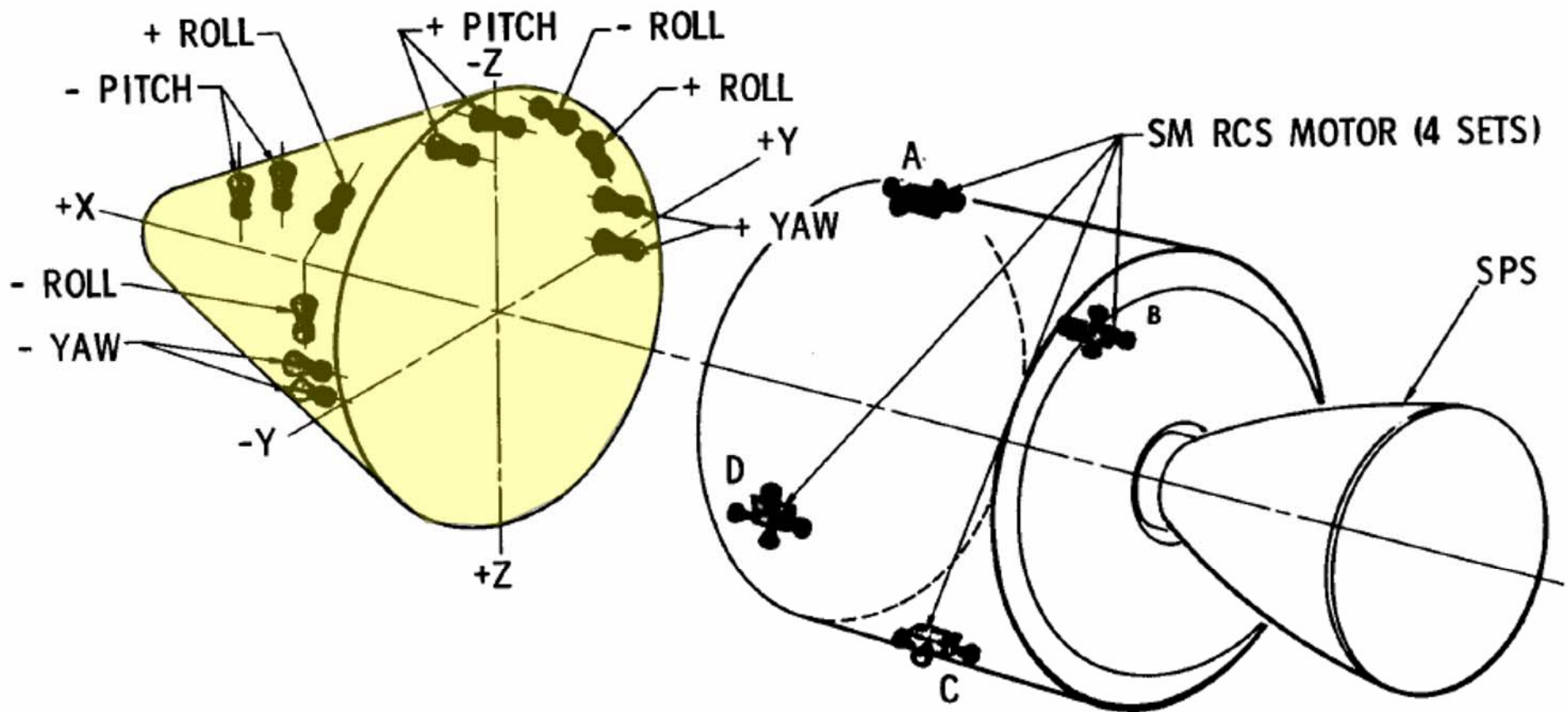


Lesson Objectives

- Define the systems for CSM propulsion and control
- List the times during the mission at which each system was used
- Describe the basic components and operation of the
 - Service Propulsion system (SPS)
 - SM Reaction Control System (SM RCS)
 - CM Reaction Control System (CM RCS)



CSM Propulsion Systems

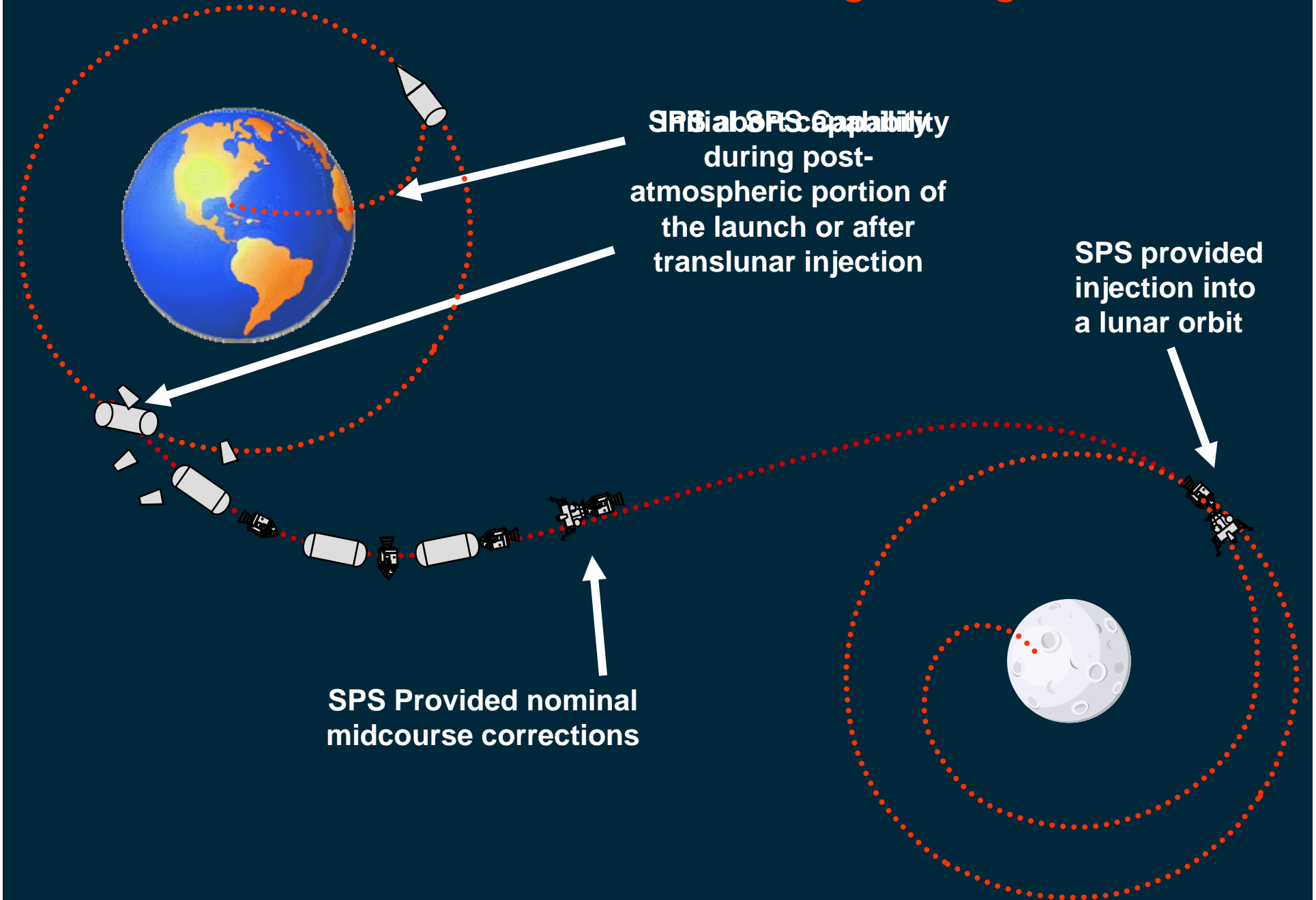


SPS Usage Throughout the Mission

SPS Capability during post-atmospheric portion of the launch or after translunar injection

SPS provided injection into a lunar orbit

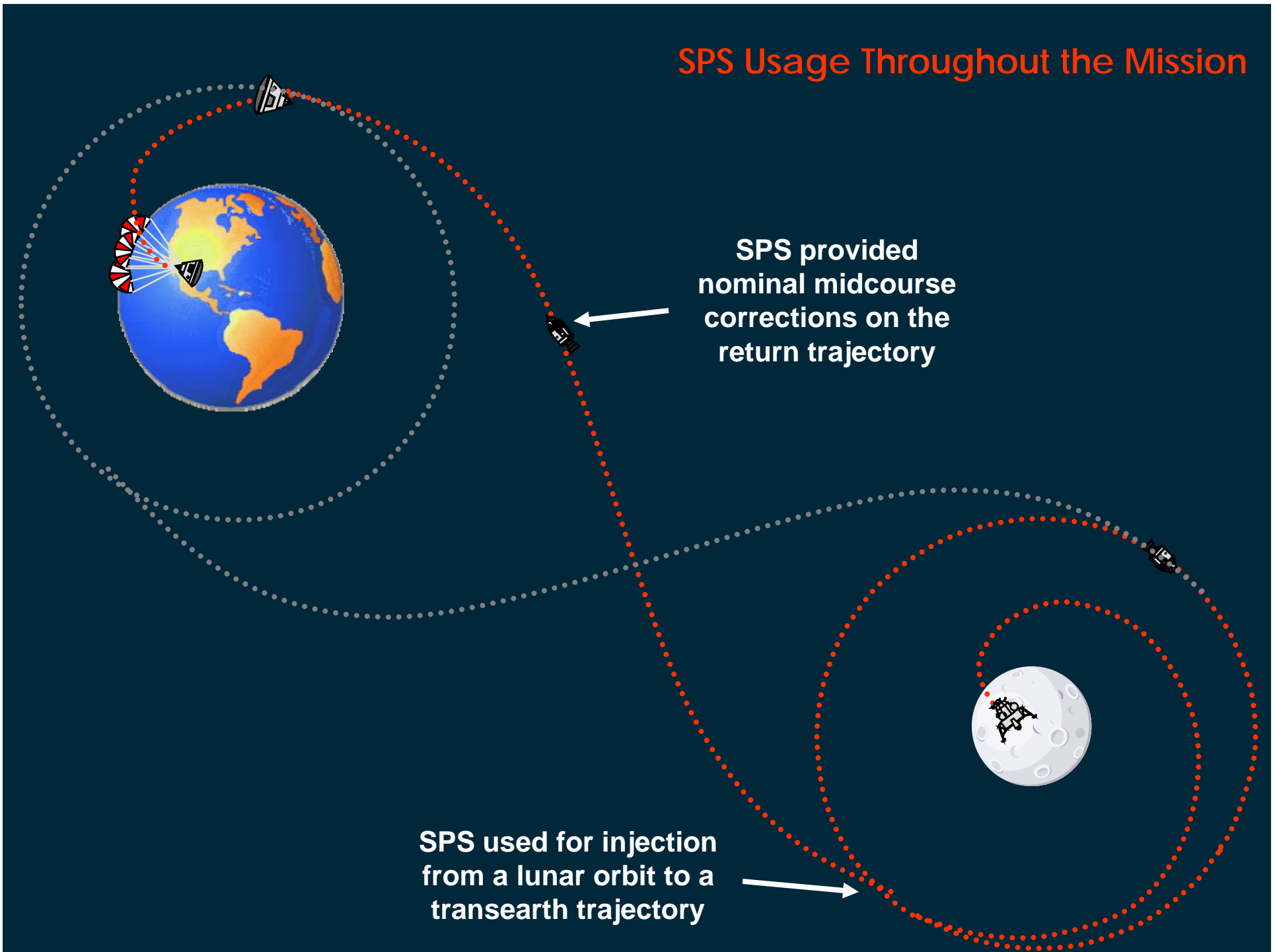
SPS Provided nominal midcourse corrections



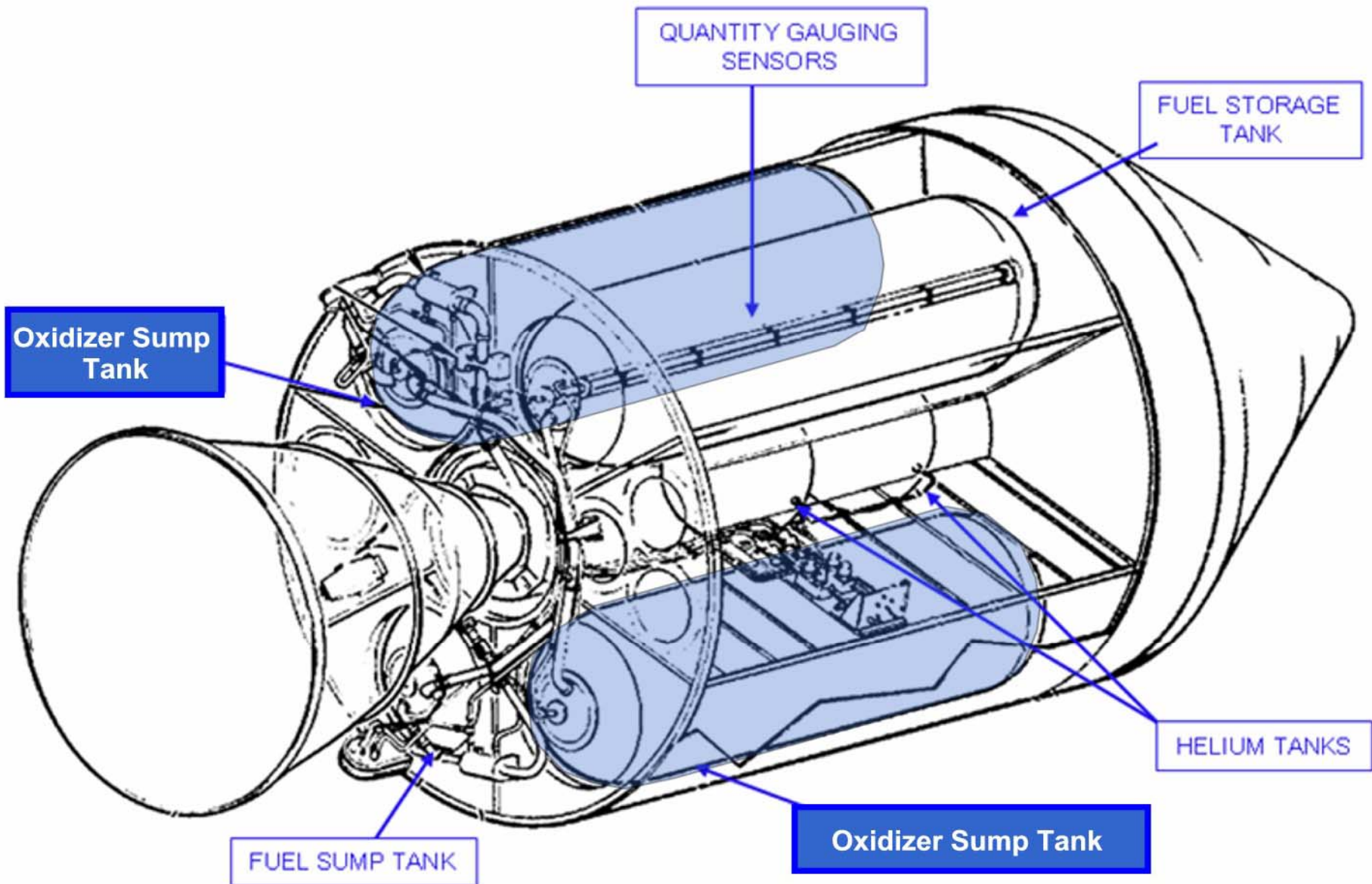
SPS Usage Throughout the Mission

SPS provided
nominal midcourse
corrections on the
return trajectory

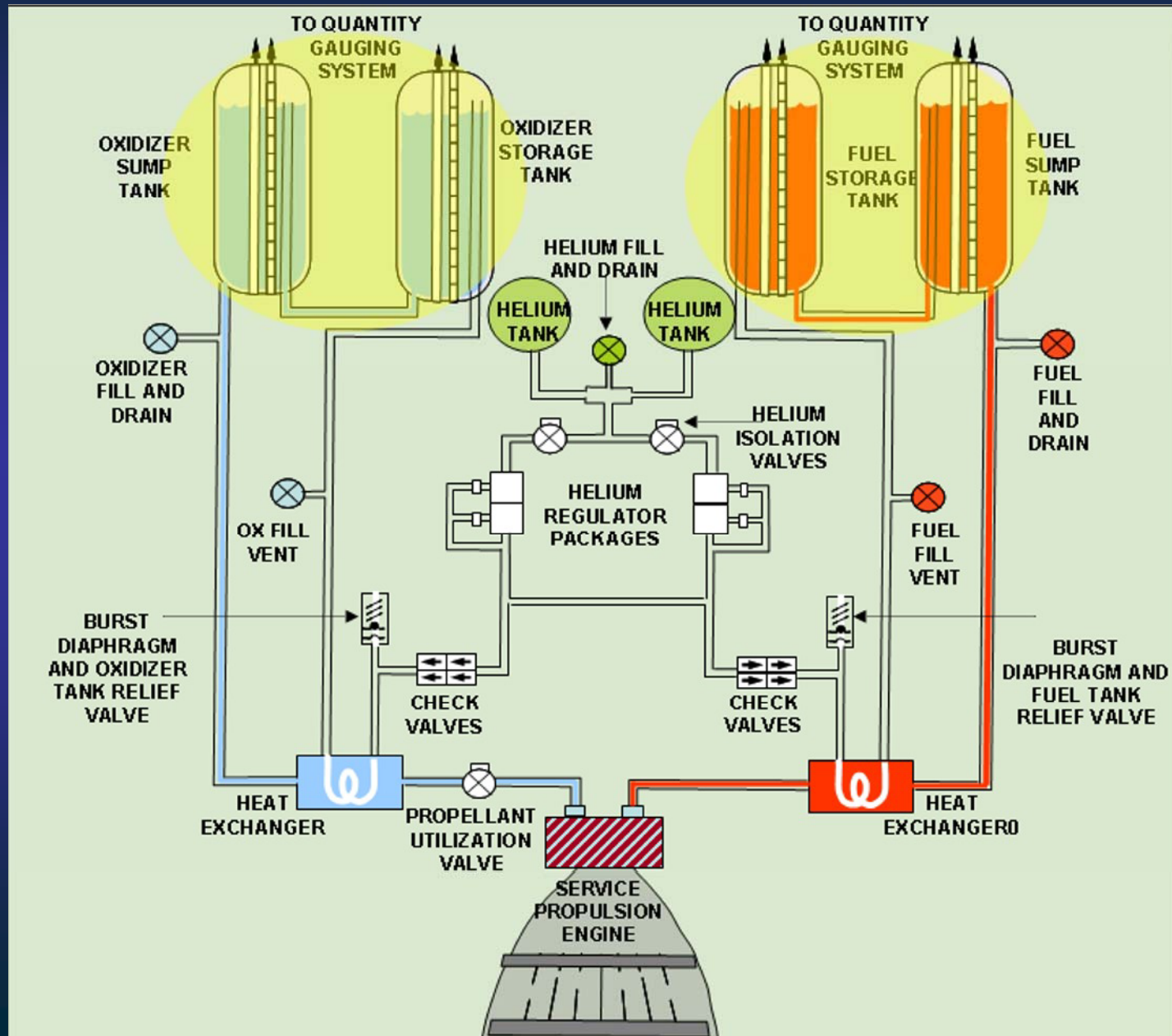
SPS used for injection
from a lunar orbit to a
transearth trajectory



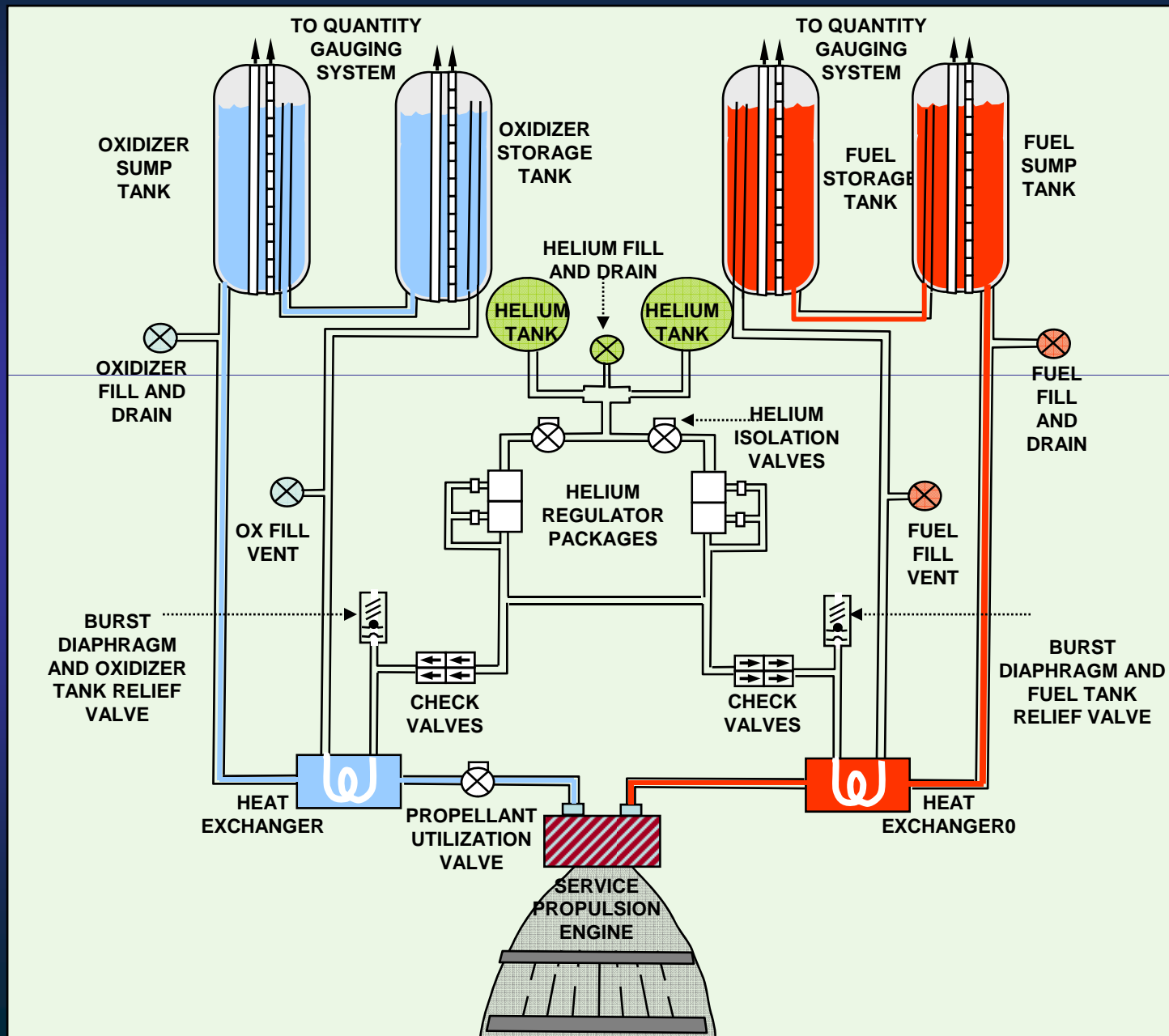
SPS Component Overview



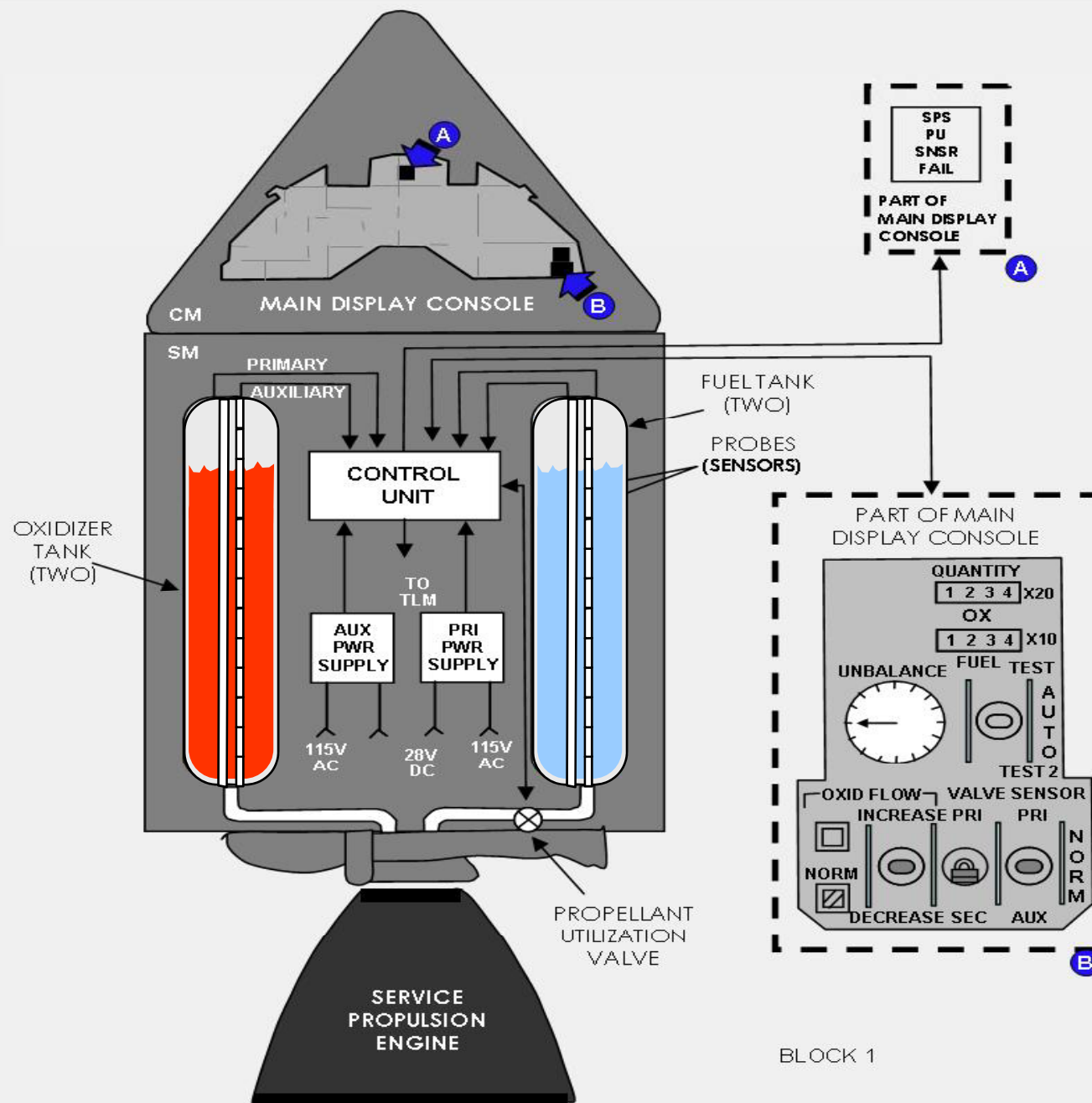
SPS Propellant Pressurization and Flow



SPS Propellant Pressurization and Flow



SPS Propellant Gauging



- Pressure fed engine
 - Hypergolic propellants
- Provided 91kN
(20,500 lbs) of thrust
- Non-throttlable
- Restartable
- Gimbals for thrust
vector control

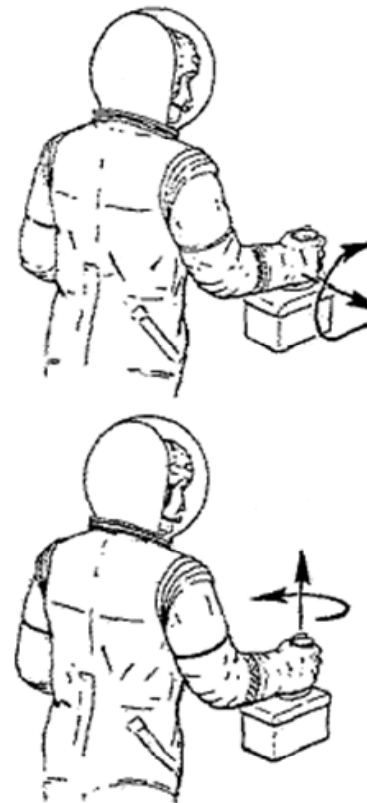
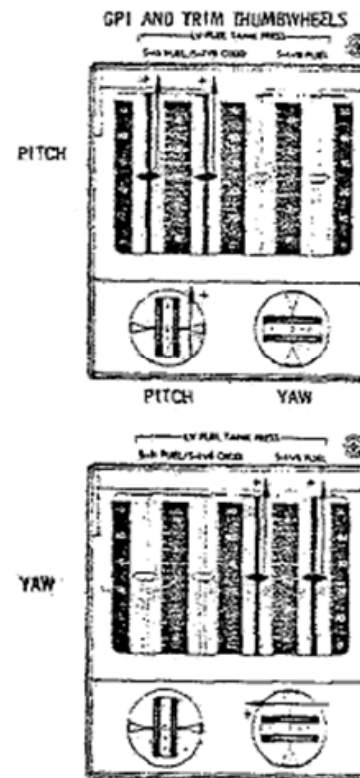


SPS Operation

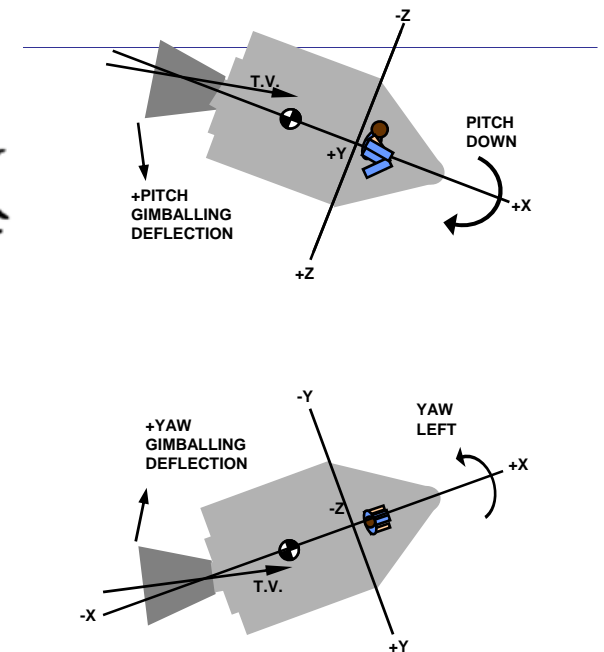
Crew (Manual)

Guidance and
Navigation System

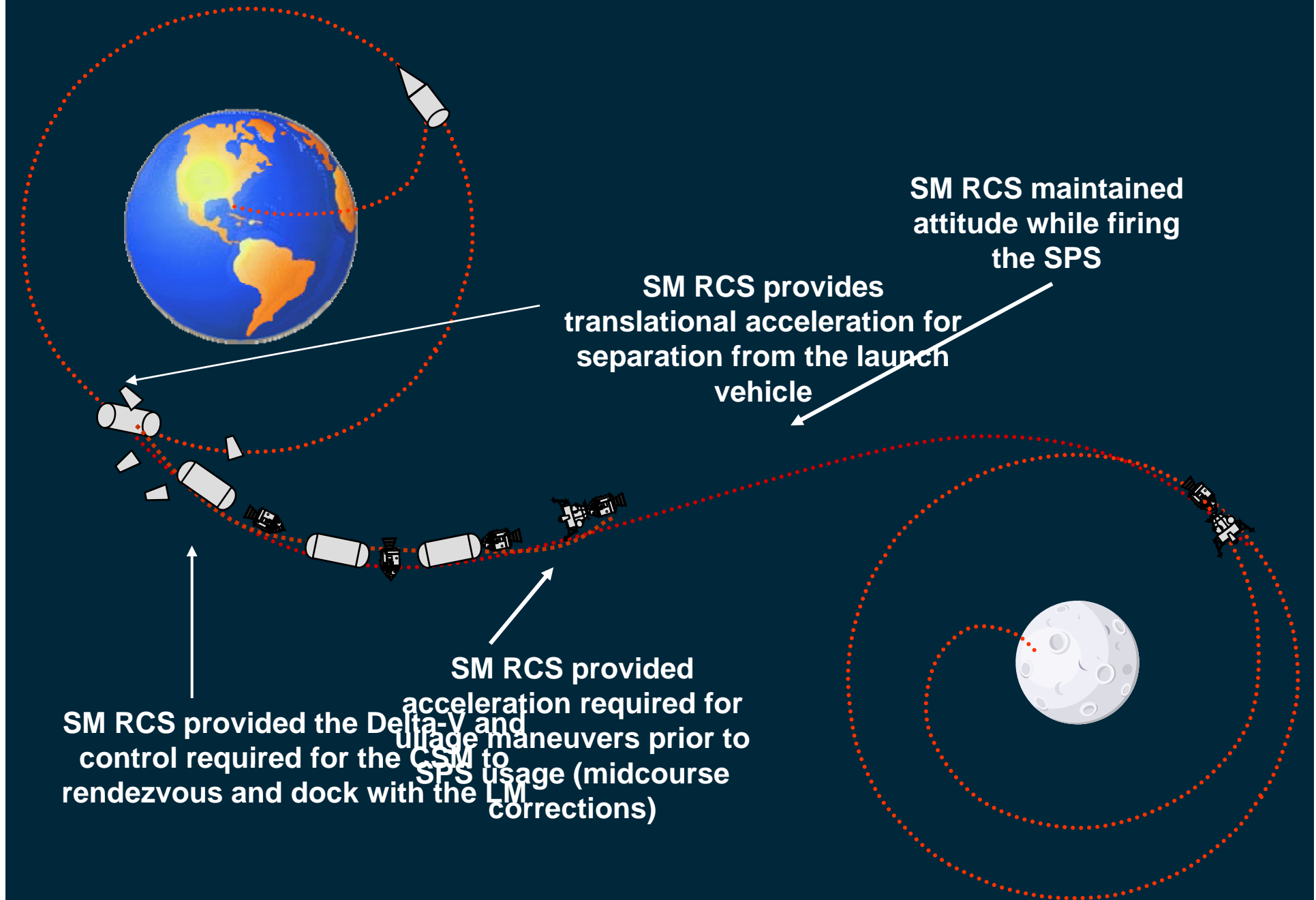
Fire command



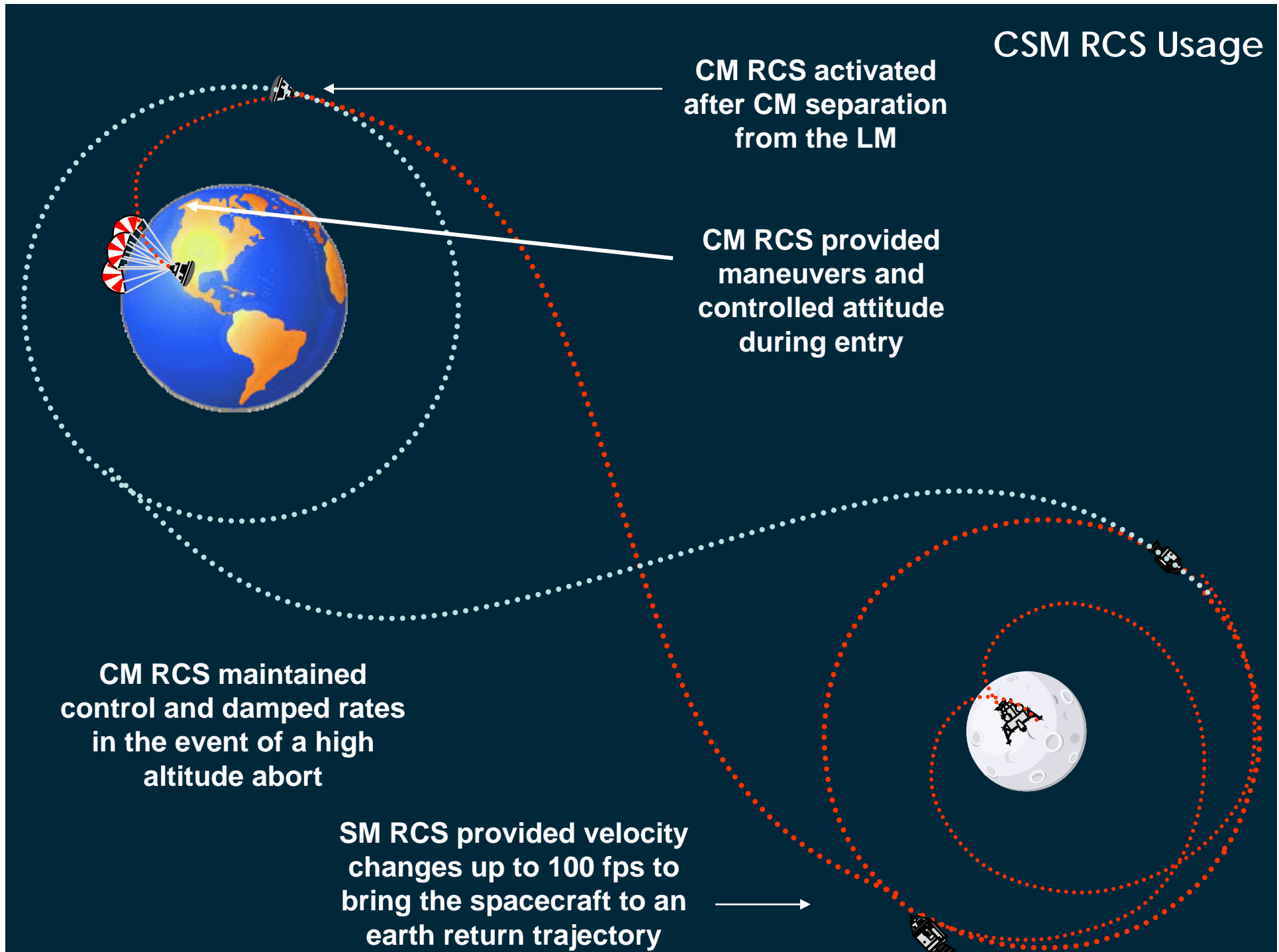
CSM ROTATIONS



CSM RCS Usage

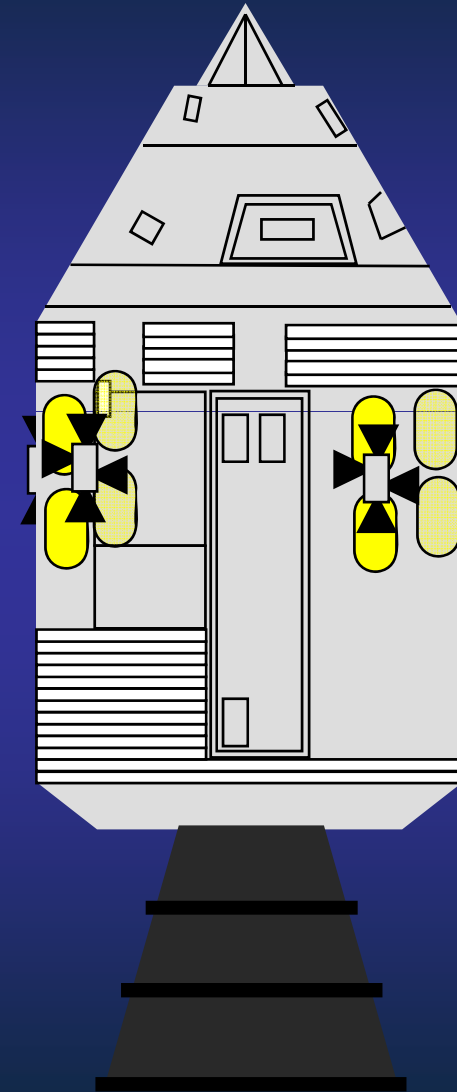


CSM RCS Usage

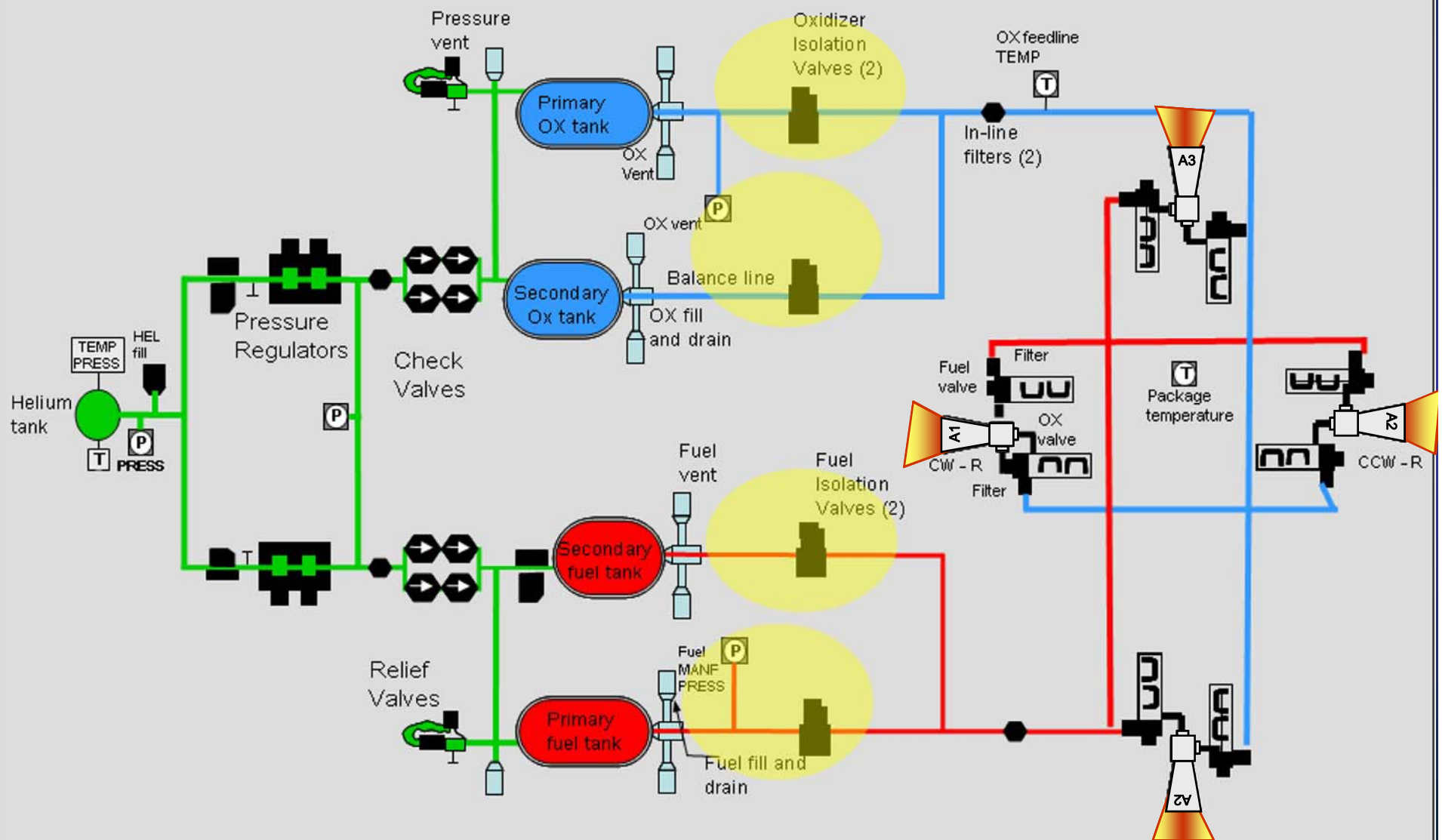


SM RCS Overview

- 4 separate reaction control system units
- Each contained:
 - Two oxidizer tanks
 - Two fuel tanks
 - One helium tank
 - 4 Thrusters
- Thrusters
 - Pressure fed
 - 445 N (100 lbs) of thrust each

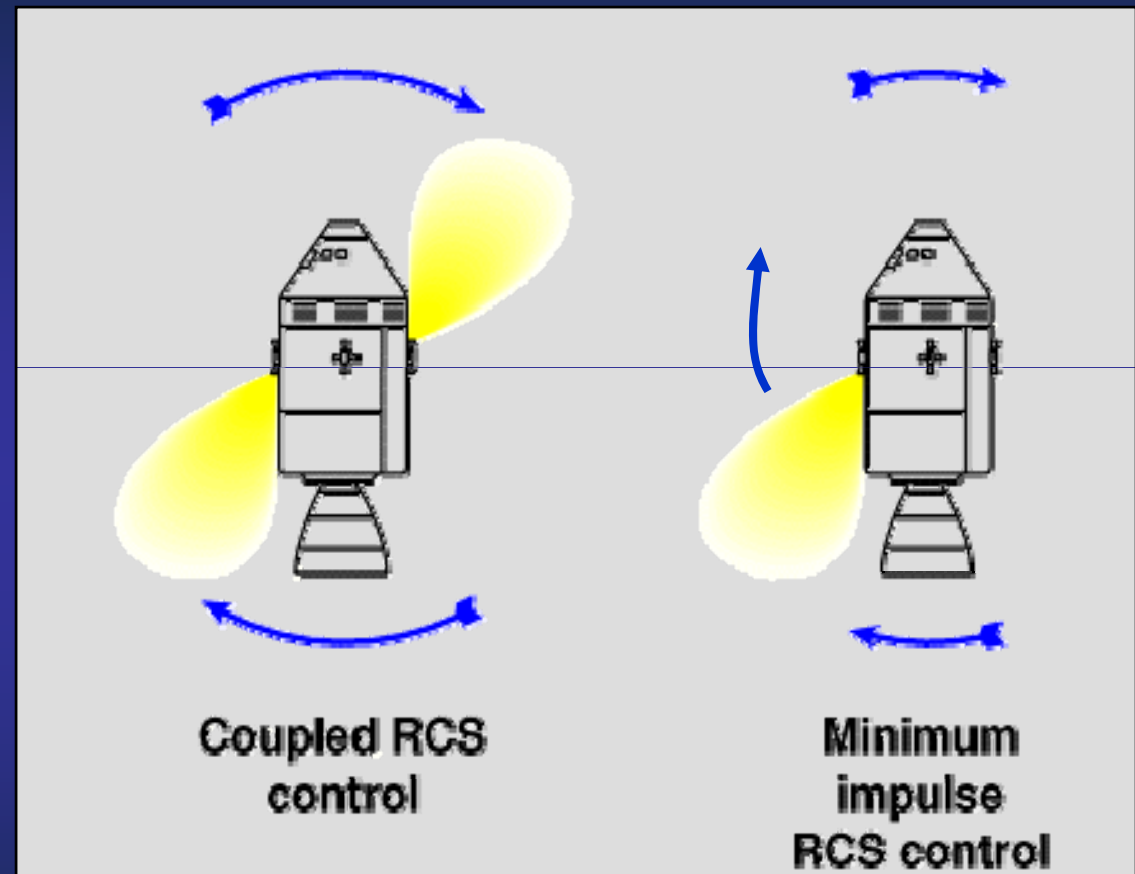


SM RCS Propellant Pressurization and Distribution



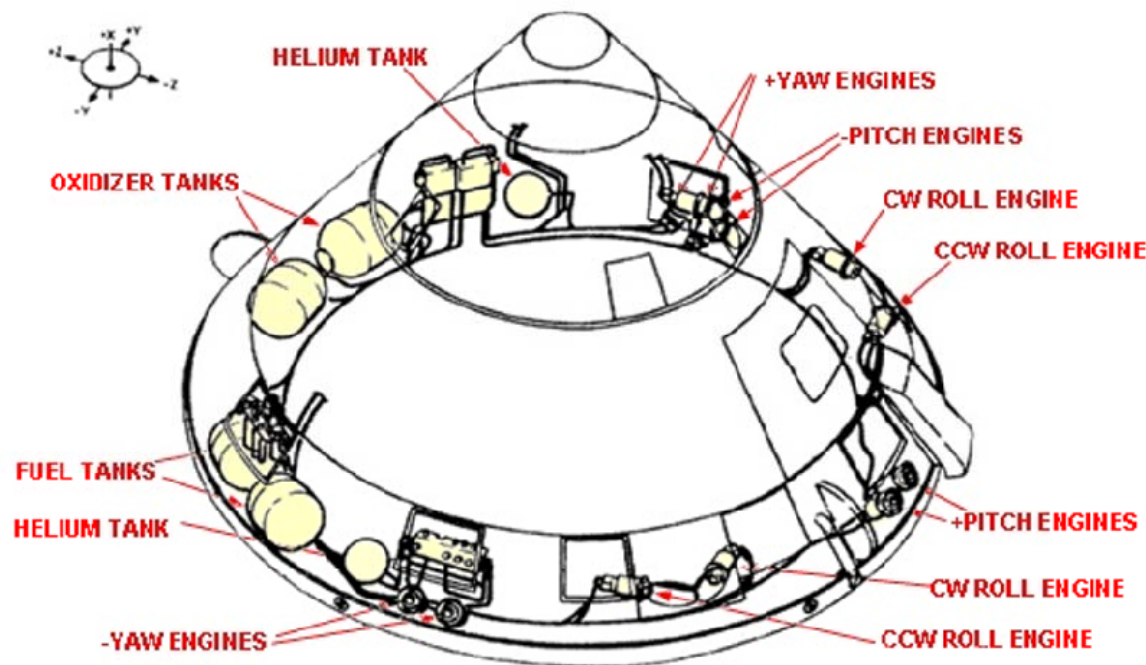
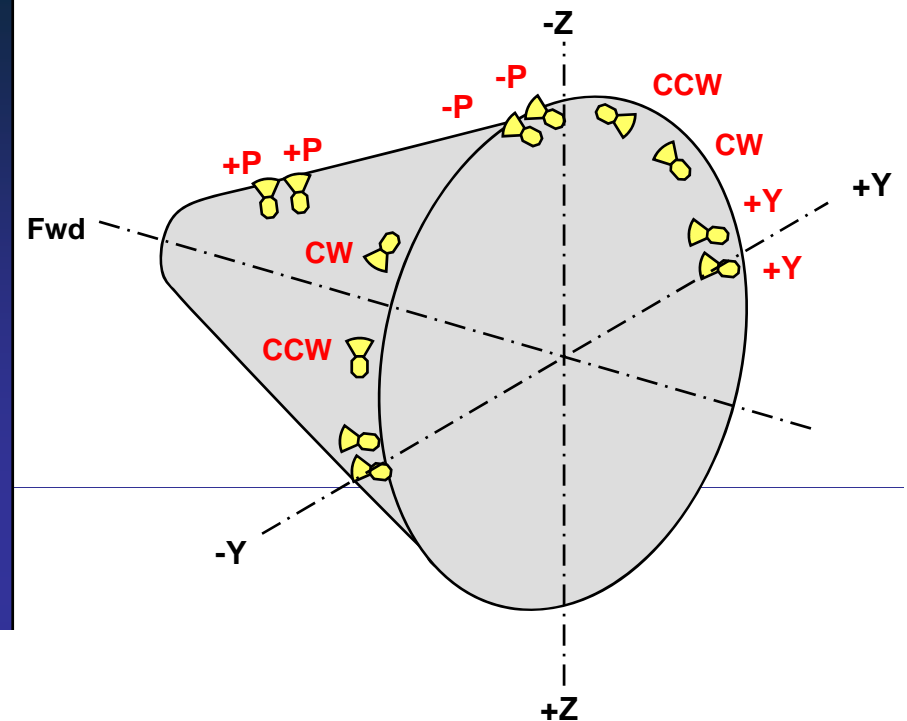
SM RCS Thrusters

- Four engines in each of the 4 reaction control units
 - Units used simultaneously
 - 3 units could control if one failed
- Engine fire commands generated from the Stabilization and Control System
- Backup manual option

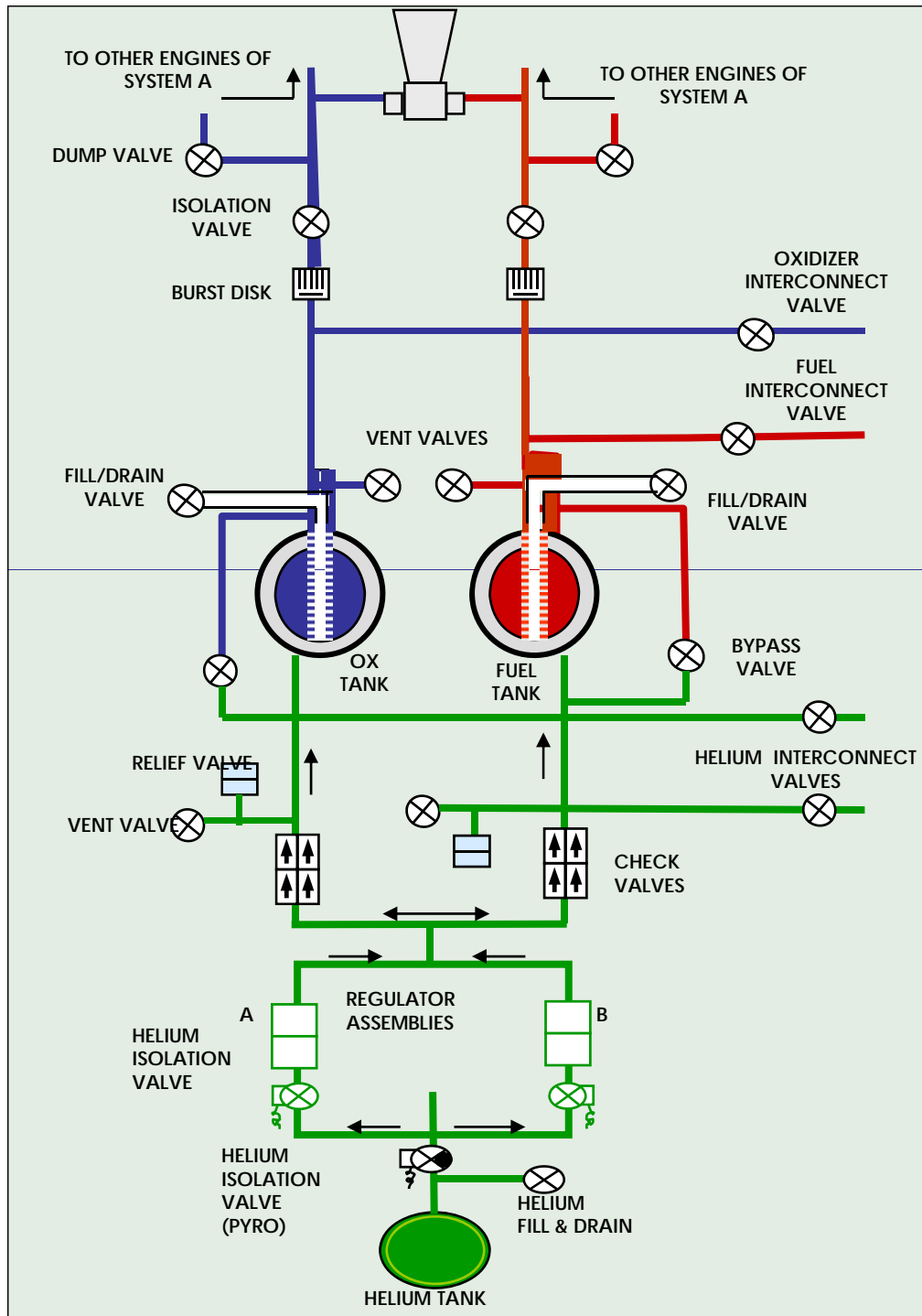


CM RCS Overview

- Two separate CM RCS systems
- Systems nominally worked together but either could maintain control



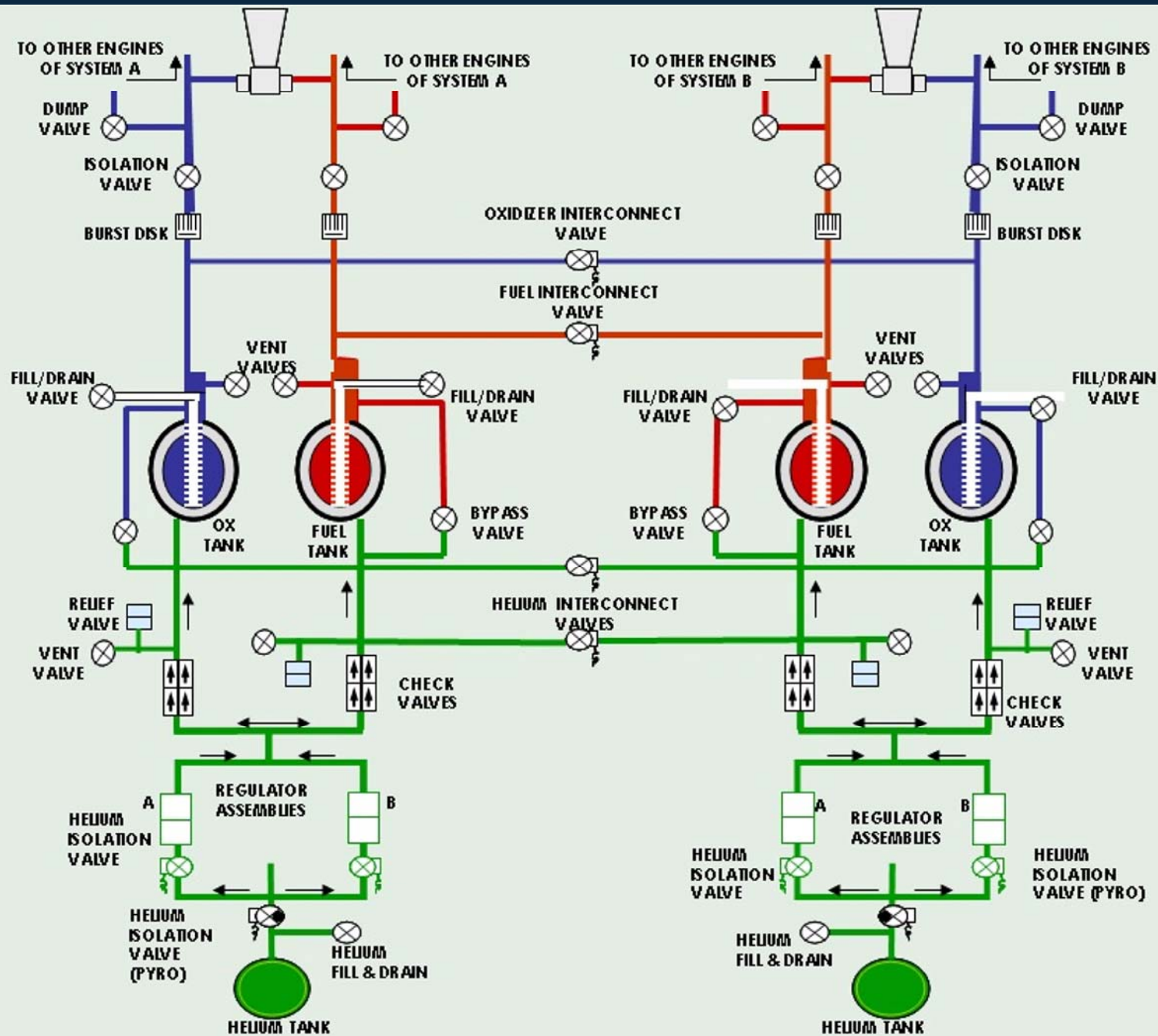
- Each system contained
 - One helium tank
 - One oxidizer, one fuel tank
 - Six thrusters
 - ~413 N (93 lbs) of thrust each



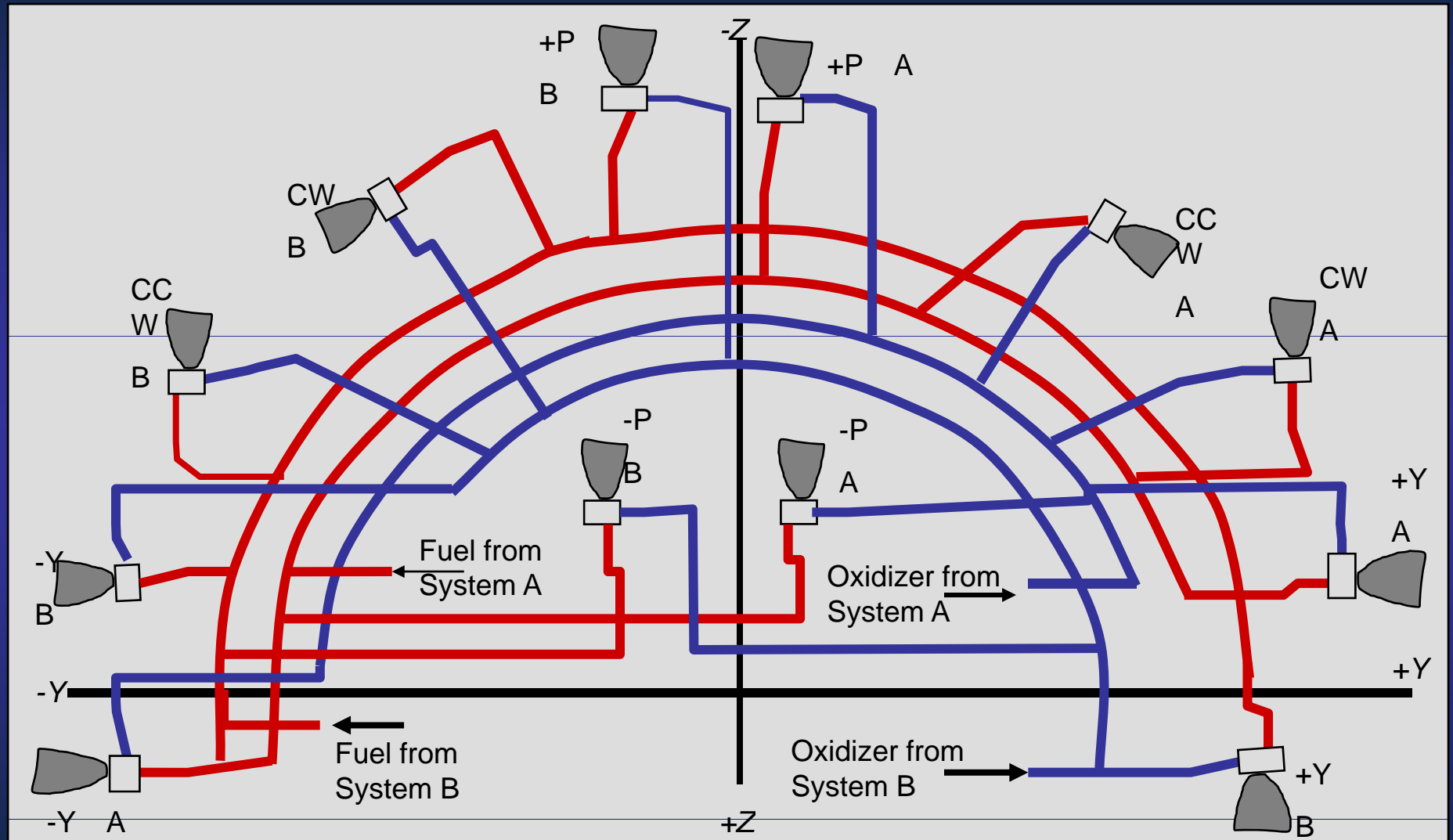
CM RCS Prop Flow and Distribution

- Two identical systems, A and B
- Similar components to SM RCS
- Interconnect capability between the two systems

CM RCS Prop Flow and Distribution



CM RCS Thrusters



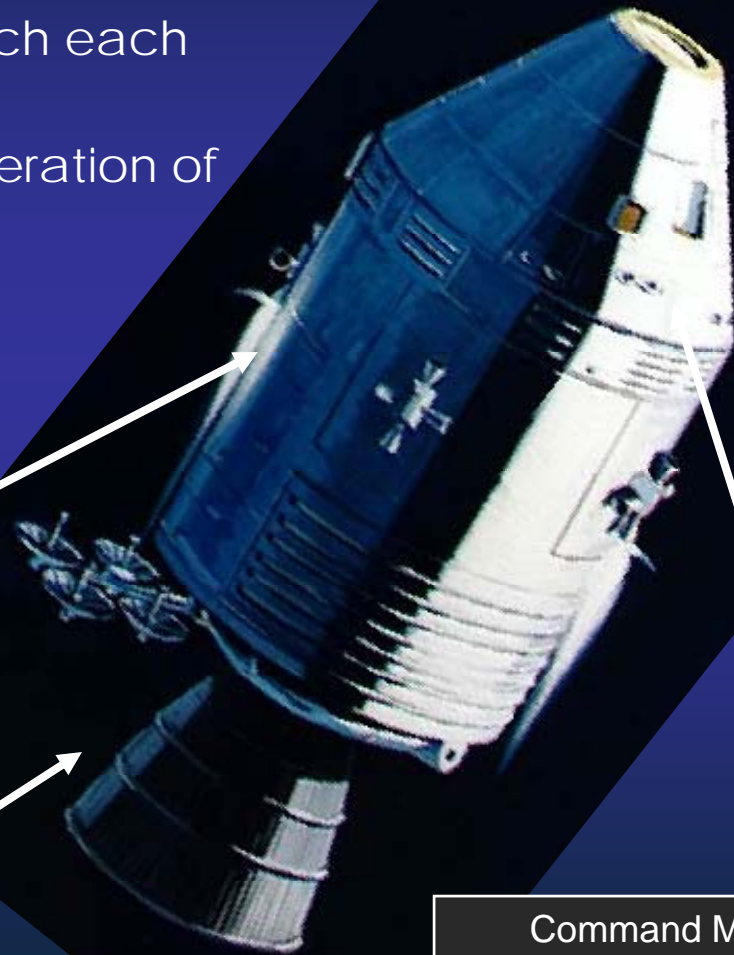
CSM Propulsion Summary

- Define the systems for CSM Propulsion and control
- List the times during the mission at which each system was used
- Define the basic components and operation of the
 - SPS
 - SM RCS
 - CM RCS

Service Module Reaction
Control System
(SM RCS)

Service Propulsion System
(SPS)

Command Module
Reaction Control System
(CM RCS)



REFERENCES

- <http://images.jsc.nasa.gov/lores/S66-10998.jpg>
- <http://www.hq.nasa.gov/office/pao/History/SP-350/profile.html>